Meteorological record at Hill Gardens, Jamaica.

August, 1897.	Pressure.		Temperature.				Dew point.		Relative humidity.		Precipitation.	Wind.			
												Direction.		Movement.	
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Maximum.	Minimum.	7 a.m.	3 p.m.	7 a.m.	3 p.m.		3 p.m.	7 a.m.	3 p.m. to 7 a.m.	7 a.m. to 3 p.m.
1....	25.36	25.35	63	66	69	58	61	62	96	87	0.45	se.	se.	25	10
2....	25.35	25.34	64	68	70	58	53	63	67	81	0.05	se.	se.	5	5
3....	25.35	25.36	63	68	72	60	57	62	80	81	0.00	e.	......	5	0
4....	25.39	25.43	65	68	74	60	59	64	81	87	0.00	e.	e.	5	5
5....	25.40	25.47	66	73	76	59	62	64	87	73	0.00	e.	e.	5	5
6....	25.45	25.44	66	69	75	61	62	63	87	81	0.00	e.	e.	10	5
7....	25.46	25.41	64	71	75	60	62	60	93	68	0.00	se.	e.	15	5
8....	25.45	25.41	62	68	70	60	58	64	86	87	0.00	se.	......	5	0
9....	25.39	25.38	62	77	78	60	58	55	86	46	0.28	se.	e.	10	4
10...	25.45	25.41	62	75	76	62	57	66	70	73	0.00	se.	se.	200	80
11....	25.35	25.35	65	69	77	61	57	65	75	87	0.00	se.	se.	25	10
12....	25.37	25.36	64	63	66	60	62	61	93	93	0.00	se.	e.	275	25
13....	25.43	25.42	63	71	75	58	52	65	67	81	2.15	se.	e.	25	5
14....	25.39	25.40	61	72	73	59	59	61	93	68	0.00	se.	e.	50	5
15....	25.42	25.38	66	69	70	58	64	62	93	78	1.10	se.	se.	125	10
16....	25.40	25.41	62	74	75	60	58	58	86	57	0.07	se.	se.	185	25
17....	25.40	25.41	64	72	76	61	58	61	80	68	0.00	se.	e.	100	10
18....	25.43	25.42	64	73	77	59	54	59	72	61	0.00	e.	e.	55	5
19....	25.44	25.43	65	69	76	60	61	62	87	78	0.00	e.	e.	50	10
20....	25.43	25.43	64	66	72	61	60	64	86	91	0.00	se.	e.	5	5
21....	25.42	25.41	64	68	72	61	60	64	86	87	0.00	se.	e.	5	10
22....	25.46	25.40	66	70	74	59	62	66	87	87	0.00	se.	......	10	0
23....	25.43	25.43	64	69	70	60	56	62	75	78	0.00	e.	......	5	0
24....	25.45	25.45	64	64	70	61	58	62	80	93	0.00	e.	......	5	0
25....	25.38	25.36	64	64	72	58	58	62	80	93	0.40	se.	se.	50	5
26....	25.39	25.32	64	70	72	61	58	66	80	87	0.25	se.	se.	150	15
27....	25.36	25.33	62	64	70	60	58	62	86	93	0.15	se.	......	10	0
28....	25.32	25.32	63	65	69	56	52	63	67	93	0.16	e.	se.	5	5
29....	25.37	25.33	64	65	69	58	62	63	93	93	0.07	se.	se.	15	5
30....	25.34	25.34	65	64	69	60	59	62	81	93	0.00	e.	......	10	0
31....	25.35	25 33	61	66	69	60	59	64	93	91	0.25	e.	......	5	0
	25.405	25.393	63.7	68.4	72.5	60.0	58.6	63.0	83	81	5.38	ese.	ese.	46.7	8.6

FORMS OF LIGHTNING.

In his meteorological essays, Arago collects and classifies the descriptions of the different forms that lightning assumes. The *first class* consists of narrow, thin, sharply-defined, luminous lines which may have crimson, violet, or bluish colors. These lines may be classified as straight or slightly curved, zigzag or broken lines, greatly curved and even reentrant, and, finally, forward and return, very nearly resembling the capital letter V. We have also single flashes that bifurcate into a collection of smaller flashes that may number anywhere from two to one hundred, the double and triple forks being least frequent. To these varieties the Editor would add a sinuous form of lightning flash that he has seen on several occasions, both in Chicago and Washington, in which the flash appears to run with comparative slowness, horizontally, along the under surface of a cloud, dying out after it has pursued a path whose apparent angular length is from *one* to *five* degrees. No noise whatever usually accompanies this lightning, although the flashes may be in the zenith. When last observed, in May, 1897, it seemed possible that these might be simply long flashes viewed endwise, so that the apparent path, which was sometimes so curved as to form a complete oval or spiral, was simply the projection of what would from another location have appeared to be a long flash between an upper and a lower cloud.

The *second class* recognized by Arago is that of the diffuse lightning, spreading over immense surfaces, often of an intense reddish tinge, but sometimes blue or violet, and which in America and England are spoken of as "heat lightning," but which are more properly called "sheet lightning." During an ordinary thunderstorm the sheet lightning is far more frequent than the flash lightning.

The *third class* includes the mysterious "globular or ball lightning" which rolls about on the ground and has thus far defied all attempts at satisfactory explanation.

As a *fourth form* of electric discharge we must reckon the continuous emission of light from the surface of certain clouds. As these clouds are low, and as the light dies away after a few minutes only to be renewed again after a short interval, we must consider this light as due to myriads of little flashes between the particles of the clouds without appreciable noise.

Besides the lightning interchanged between the clouds, or the clouds and the earth in ordinary weather, a still more interesting *fifth class* should be made of those that play between the earth and the cloud of ashes and vapor formed above a volcano in active eruption.

There does not seem to be any evidence that in these five classes there is any special new production of electricity. We have only to consider the earth as the electrified body, permanently electrified and always, by induction, inducing electric manifestations in every substance that is near to it. The auroral light ought to be included as one form of the lightning discharge, since it is certainly a form of electric discharge modified by the rarity of the upper atmosphere from the flash to the stratified sheet lightning. The electric discharge is modified, not merely by the rarefaction of the dry atmosphere of oxygen and nitrogen, but still more so by the rarefaction of the other gases in the atmosphere, such as the hydrocarbons and the carbonic acid gas, and probably also by that of the aqueous vapor, so that air, which is very dry or very cold, and therefore contains but little aqueous vapor, may have much to do with the formation of auroras. According to the recent researches of Professor Trowbridge, the character of the electric current as to intensity and quantity is also a prime factor in determining the character of the luminosity. He has been able to reproduce a great variety of forms of lightning, such as have been photographed from time to time by proper alterations in his apparatus.—[C. A.]

RESULTANT AND PREVAILING WINDS.

In response to a request from Mr. Fred. A. Tower, voluntary observer at Concord, Mass., the Editor submits the following note with reference to the meaning and the method of deducing the resultant and the prevailing winds.

The resultant may be conceived of as computed by either one of two different methods. Both give the same resultant but suggest very different interpretations as to what that resultant means. In the first method, the observer plots upon a sheet of paper the wind movement, as to its length and direction, for the first hour; at the end of that line as a starting point he plots the motion for the second hour, and at the end of that the motion for the third hour, and so on. His sheet of paper soon becomes covered with a very irregular broken line and if at any moment he stops this process and draws a heavy straight line from the start point to the end point, this will represent, both in length and direction, the resultant wind. When constructed in this way, under the implied assumption that the individual observed winds are all horizontal motions, the diagram accords with the idea that a particle of air has actually followed this irregular broken line, and has finally arrived at its end point just as a vessel, sailing irregularly in all possible directions, must finally arrive at a spot that represents the resultant of its efforts to sail in a straight line. Such diagrams and such an interpretation are perfectly proper for vessels on the ocean, and especially for plotting ocean currents by means of floating wrecks, but the interpretation is not proper in the case of the wind because it is probable that a particle of air never pursues a horizontal movement for any long period of time.

The second method of computing the resultant consists in classifying all the movements according to the direction in which they occurred, and summing them up so that we have, as a grand total, *a* miles from the north, *b* miles from the northeast, *c* miles from the east, etc. The north and south movements partly offset each other, so also the northeast and southwest, the east and west, the southeast and northwest, so that we finally have four equivalents which may then be combined into one resultant. This resultant will be the same as that obtained by the preceding graphic method, but it suggests a very different interpretation, viz, we do not think of a particle of air as having traveled continuously during the whole time to a very considerable distance away from the station, but rather consider it as having been kept at the station and successively subjected to these various hourly movements. From this point of view the resultant expresses what happened at the station to the wind vane and anemometer, and does not lead us to imagine that any great mass of air necessarily took part in the movements. This is a more rational interpretation, for every station is liable to have local peculiarities which must not be allowed to interfere with our interpretation of the general movements of the atmosphere in its neighborhood.

The total resultant above referred to considers all the observations made continuously hour by hour and day by day, but we may classify the observations by hours and compute the resultants for each hour separately. If we wish a total resultant, and are willing to base it upon only a few hourly resultants, we may select such hours as will give resultants that are approximately the same as those deduced from twenty-four hourly observations, and this is, approximately, what is done when we compute resultants from 8 a.m. and 8 p.m., as is done for the regular Table VIII of the MONTHLY WEATHER REVIEW. If, furthermore, experience should show that resultants computed by using the exact measured miles per hour differ but little from resultants computed by assuming that the average velocity of the wind is the same for all hours of the day, then one might be justified in omitting the labor of plotting or calculating the exact number of miles, since the defects of one hour would make up for the excesses of the next. This further simplification is especially allowable when, as in the computations for Table VIII, we restrict ourselves to an approximation deduced from two observations per day. The resultant winds given in Table VIII have not, thereby, lost in accuracy so much as we might at first thought anticipate. Their accuracy is quite comparable with that of the other meteorological elements with which they are likely to be compared, more especially the barometric gradients shown upon Chart No. IV, whose isobars are also based upon observations at 8 a.m. and 8 p.m.

The figures in the four principal columns of Table VIII are, therefore, deduced from the simple count of the frequency of the wind directions at 8 a.m. and 8 p.m., without having regard to the velocity or force of the wind; for instance, at Eastport, Me., the 60 observations during 30 days were distributed as follows: North, 10; northeast, 4; east, 4; southeast, 2; south, 10; southwest, 8; west, 8; northwest, 9; calm, 5. The four northeast winds are equivalent to 3 north and 3 east. Similarly, the southeast 2 are equivalent to 1 south and 1 east; the southwest 8 are equivalent to 5 south and 5 west; the northwest 9 are equivalent to 6 north and 6 west, so that if we add the four components we have north wind, 19; south wind, 16; east wind, 8; west wind, 19. The five calms do not affect the motion. The balance between north and south leaves north, 3; the balance between east and west leaves west, 11. Therefore, the resultant is a movement of 3 from the north and 11 from the west, which is the same as a movement of a little over 11 from the direction north 80° west.

The prevailing wind is determined by simply selecting that wind direction which occurs most frequently, that is to say, in the preceding case for Eastport, north and south would have an equal claim on our attention because both occurred 10 times, and the northwest would be almost on the same footing because it occurred 9 times. The prevailing wind does not convey to the mind any proper idea of the wind at a station unless some one direction occurs in an overwhelming majority of cases. The actual number of winds from each direction must be enumerated if we would have a datum that in any way replaces the resultant wind. Such a detailed statement is all the more important when there is a large number of winds alternately opposed to each other, thus in the case of strong land breezes by night and sea breezes by day, the resultant may be zero, or very small, whereas the statement of the frequency of each wind, or the analysis into the four principal components, gives one a clear idea of the alternate opposition of these breezes.—[C. A.]

FROST FORMATION IN ST. PAUL.

Mr. H. Volker, observer, Weather Bureau, St. Paul, Minn., has kindly forwarded to the Editor an account of an interesting case of frost formation. He submits a rough draft of the iron bridge across the Mississippi at Robert street. This bridge consists of iron framework, 870 feet long, as its southeastern portion and a similar framework, 330 feet long, as its northwestern portion. The central portion of the bridge is an iron truss, 340 feet long, resting on two slender stone pillars at 80 feet above low water. The central portion of the roadbed of the bridge is horizontal, while the roadbeds connecting this with the extremities have a gentle slope. Mr. Volker observed that on the early morning of September 20, when the minimum temperature at the Weather Bureau station was 38°:

> Not a sign of frost was to be seen on the level, central portion of the roadway, but on both inclines it was formed copiously, and, what was most remarkable, the line of frost extended up the inclines to the very point where the level portion begins, both on the northwest and on the southeast sides.

Mr. Volker states that the formation of frost was due not merely to the elevation and the cooling by radiation, but that—

> The sloping condition of the roadway was especially favorable for frost formation, and, if this had continued, frost would still have formed at a higher elevation, probably for hundreds and possibly for thousands of feet. From this I conclude that frost on sloping elevations, sides of hills and mountains, is formed in the same manner. If radiation and elevation were the only causes in such frost formations, then in this case frost should have disappeared gradually and not abruptly, for the elevation of the upper ends of the sloping roadways was equal to that of the level portion of the bridge.

We have no doubt that Mr. Volker is correct in attributing the abundant formation of frost on the sloping roadways to that inclination itself. Unless there were great differences in the velocity of the wind, the whole surface of the road, both horizontal and inclined, would cool down to about the same temperature during the nighttime, and the quantity of frost would depend principally upon the quantity of cold air flowing gently over the surface of the roadway. If there were no wind, then this quantity must have been much greater down the sloping approaches than along the central, level part, owing to the fact that the flow of air over the level portion is almost *nil*, while that down the slope is very appreciable. It can, however, happen that the slope may be too steep for the deposition of frost. Anyone can make the experiment by exposing at nighttime several wooden planks at a few feet above the ground, one of them horizontal, another slightly, and a third steeply inclined. There should be a raised rim on the edges of the planks, so as to force the air to flow downward the whole length of the planks. If, as we suppose, Mr. Volker's explanation is correct, the deposit of frost should be thickest on the plank that has a gentle slope.—[C. A.]

THE HANDBOOKS OF THE DEUTSCHE SEEWARTE.

One of the most important lines of practical work undertaken by the Deutsche Seewarte when reorganized in Decem-